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Clinical, haematobiochemical, ultrasonographical, and ruminal alterations in camels diagnosed with various digestive troubles

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ABSTRACT

Seventeen she camels aged (8-10) years old and weighting (350- 400) kg were screened for the digestive disorders. Seven camels (40%) were healthy and set as control, four camels (24%) suffered from simple indigestion(SI), three camels (18%) suffered from ruminal acidosis (RA), and three camels (18%) suffered from other digestive disorders (12% foreign body and 6% liver fibrosis).Results of clinical examination revealed that body temperature, respiratory rate, and pulse rate were significantly ($P < 0.05$) increased in RA group compared to control while ruminal movements in both RA and SI groups were significantly decreased. The hematological findings showed significant increase in Hb, RBCs, PCV%, WBCs, and platelets in RA group compared to control. Biochemically, there was a significant increase in ALT, AST, GGT, urea, Creatinine, and K and significant decrease in ALP, albumin, globulin, total protein, A/G ratio, Na, Cl, Ca, P and Mg in RA group compared to control. Ruminal juice examination revealed a significant increase in SAT, MBRT, and significant decrease in ruminal pH, protozoal count and activity in both RA and SI groups. Ultrasonographically, the ruminal wall and reticular wall thickness were significantly increased in RA group only while small intestine diameter was significantly increased in both RA and SI groups. The content of abomasum and small intestine appeared more echoic in both RA and SI groups. It is concluded that different types of indigestion, particularly the RA can produce hematobiochemical and ultrasonographical changes with alterations in ruminal juice characters in camels.

1. INTRODUCTION

Diseases of camel gastrointestinal tract are very important as ruminal acidosis, simple indigestion, bloat, swallowed foreign bodies, enteritis, constipation (Fowler and Bravo, 2010). The term indigestion means the disruption of normal reticulorumen function. According to this description, indigestion is a group of problems that include abnormal fore stomach motility or abnormal fermentative activity, leading to abnormal reticulorumen contents (Garry, 2009).

Ruminal acidosis is defined as a metabolic disorder of gastrointestinal origin mainly noticed in animals consuming large amount of diets rich in cereal grains, affecting its performance (Jaramillo-López et al., 2017). Ruminal acidosis is characterized by loss of appetite, depression and death it is also known for ruminal overload, acute compression of the rumen and indigestion for carbohydrates. Ruminal acidosis is divided into several forms acute, mild which similar to simple indigestion and a chronic form (sub-acute) (Walker, 2006).

Simple indigestion is a disease characterized by acute onset. It is associated with the change of the diet abruptly leading to self-limiting but rapid decline in rumen fermentation (Garry, 2009). Ruminal acidosis is differentiated from simple indigestion by its greater severity and the pronounced fall in the pH of the ruminal juice to <5.5(Pagana and Pagana, 2016).

Recently, the ultrasonographic appearance of the normal gastrointestinal tract in healthy camels was provided that could be used as a reference for the interpretation of suspected digestive abnormalities (Tharwat et al., 2012).

Therefore, the objective of the study was to screen the camels for digestive system diseases using clinical, haematobiochemical changes and ruminal juice examination. In addition, ultrasonographic evaluation of these diseases was conducted.

2. MATERIAL AND METHODS

2.1 .Experimental design:

This study was done as on a total number of 17 she camels (8-10) years old and weighting (350- 400) kg in Ras Sudr Research station. Seven camels (40%) were healthy and set as control, four camels (24%) suffered from simple indigestion (SI), three camels (18%) suffered from ruminal acidosis (RA) and three camels (18%) suffered from other digestive disorders. (12% suffered from foreign body in the ventral ruminal sac (n=2) and 6% suffered from liver fibrosis (n=1)) and were diagnosed using ultrasonography. This group was not included in haematological and biochemical analysis as they were classified as sporadic cases.

2.2 .Ethical approval:

The study was reviewed and approved by the local animal care and use committee at the faculty of veterinary medicine, Benha University under the number (BUFVTM 01-12-21).

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2.3 .Clinical examination of the animals:
Body temperature ºC, and respiratory rates, pulse rates, mucous membrane, and ruminal movement of the camels were examined and recorded following the procedures described by Radostits et al (٢٠٠٧).

2.4 .Haemato-biochemical examination:
Two sets of blood samples were obtained from each camel. The first set of samples was collected with anticoagulant for determination of hematological parameters. Complete blood counts were done by using Clindag Hematology Analyzer (HA-22 Vet)(Jain, 1990).The second set of blood samples was taken without anticoagulant for separation of serum for the biochemical determination (Abdelaal, 2019)

2.5 .Ruminal juice examination:
The ruminal juice was collected from all animals by using a simple ordinary stomach tube connecting with a suction syringe 50 ml capacity. Each sample (50 ml) was taken in a clean dry and sterile flask. Color, odor, consistency of ruminal juice was done according to Chakrabarti (2018). Sedimentation activity test was determined according the method described by Radostits et al (2007). Rumen pH, Protozoal activity, motility and count were determined according to method described by Abd El-Raof et al.(٢٠٠٧)

2.6 .Ultrasonographic examination :
The ultrasonography of digestive system of camels was done using a Portable ultrasound machine (sonovet R3, made in Korea) 3.5 MHZ curved linear probe using standardized scanning process (Tharwat et al., 2012) .

2.7 .Statistical analysis:
The data were statistically analyzed using repeated measures one way analysis of variance (ANOVA) with Dunnet's as a post- hoc test as previously described byBailey (2008). We used SPSS version 16 software to conduct this analysis. Values were represented as means ± standard error (SE). All differences were considered significantly different when P< 0.05.

3. RESULTS

3.1. Clinical examination
The Clinical examination of camels in control group and SI group revealed good healthy condition which represented as good appetite, shiny eyes and normal defecation. While camels of RA group showed decrease feed intake, weakness, depression, semisolid feces with diarrhea in some cases, with slightly distended abdomen. Regarding to systemic states, body temperature, pulse rate and respiratory rate were significantly increased in RA group while not significantly changed in SI group in comparative to control on the other hand; the ruminal movement was significantly decreased in RA group and SI group in compare with control. (Table 1).

Table (1): Clinical parameters in control group, SI group and RA group.

Parameter	Control (n=7)	SI (n=4)	RA (n=3)
Temperature(°C)	37.66±0.16 ^{b}	37.80±0.22 ^{b}	38.73±0.25 ^{a}
Respiratory rate/ minute	12.29±0.52 ^{b}	12.50±0.68 ^{b}	18.00±0.79 ^{a}
Pulse rate/ minute	35.00±1.32 ^{b}	35.75±1.74 ^{b}	49.67±2.01 ^{a}
Ruminal movement/3 minutes	2.57±0.20 ^{a}	1.25±0.27 ^{b}	0.33±0.30 ^{c}

Values with different letters within the same row differed significantly at p<0.05

3.2. Haemato-biochemical examination:
There was significant increase in Hb content, PCV%, RBCs, WBCs, neutrophils, lymphocytes and monocytes in RA group compared to control. (Table 2). Biochemically, there was a significant increase (P < 0.05) in ALT, AST, GGT, urea, BUN, Creatinine, and Kand significant decrease (P < 0.05) in ALP, albumin, globulin, total protein, A/G ratio, Na, Cl, Ca, P, and Mg in RA group only compared to control (Table 3).

Table 2: Haematological examination in control group, SI group and RA group

Parameter	Control (n=7)	SI (n=4)	RA (n=3)
Hb(gm/dl)	12.10± 0.73 ^{b}	12.23±0.97 ^{b}	14.99±1.12 ^{a}
PCV%	34.46±2.33 ^{b}	33.68±3.08 ^{b}	41.48±3.56 ^{a}
RBCs(10^{6}/µl)	4.83±0.18 ^{b}	4.39±0.24 ^{b}	5.74±0.28 ^{a}
MCV (fl)	70.21±4.57 ^{b}	77.03±6.05 ^{b}	84.56±6.99 ^{a}
MCH (pg)	23.20±1.47 ^{b}	25.68±1.94 ^{b}	32.86±0.40 ^{a}
MCHC%	33.17±0.26 ^{a}	32.98±0.34 ^{a}	32.86±0.40 ^{a}
WBCs (10^{3}/ µl)	5.55±0.83 ^{b}	6.99±1.1 ^{b}	9.08±1.27 ^{a}
Neutrophils%	50.29±2.67 ^{a}	51.00±3.53 ^{a}	51.33±4.08 ^{a}
Lymphocytes%	42.29±2.32 ^{a}	40.75±3.06 ^{a}	39.33±3.54 ^{a}
Monocytes%	4.14±0.50 ^{a}	4.00±0.66 ^{a}	4.67±0.77 ^{a}
Eosinophils%	2.43±0.66 ^{a}	3.25±0.87 ^{a}	3.67±1.00 ^{a}
basophils%	0.86 ± 0.30 ^{a}	1.00±0.39 ^{a}	1.00±0.46 ^{a}
Neutrophils (10^{3}/ µl)	2.79±0.15 ^{a}	3.56±0.25 ^{a}	4.66±0.37 ^{a}
Lymphocytes (10^{3}/ µl)	2.35±0.13 ^{a}	2.85±0.21 ^{a}	3.57±0.32 ^{a}
Monocytes (10^{3}/ µl)	0.22±0.03 ^{a}	0.28±0.05 ^{a}	0.42±0.07 ^{a}
Eosinophils (10^{3}/ µl)	0.13±0.04 ^{a}	0.23±0.06 ^{a}	0.33±0.09 ^{a}
Basophils (10^{3}/ µl)	0.05±0.02 ^{a}	0.07±0.03 ^{a}	0.09±0.04 ^{a}
Platelets (10^{3}/ µl)	157 ± 14 ^{b}	164 ± 19 ^{b}	178 ± 22^{a}

Values with different superscript letters within the same row differed significantly at p<0.05.

Table (3): Biochemical analysis of serum enzymes and metabolites in control group, SI group and RA group.

Parameter	Control (n=7)	SI (n=4)	RA (n=3)
ALT(U/L)	25.29±1.21 ^{b}	29.13±1.60 ^{b}	39.67±1.85 ^{a}
AST(U/L)	41.86±3.20 ^{b}	41.25±4.23 ^{b}	66.67±4.88 ^{a}
ALP(U/L)	81.29±2.55 ^{a}	79.75±3.37 ^{a}	41.33±3.90 ^{b}
GGT(U/L)	11.71±0.52 ^{b}	13.50± 0.69 ^{b}	16.33±0.80 ^{a}
TP(g/dl)	9.24±0.35 ^{a}	6.53± 0.47 ^{b}	6.00 ±0.54 ^{b}
ALB(g/dl)	4.40±0.34 ^{a}	3.53± 0.45 ^{b}	2.33±0.52 ^{b}
Globulin(g/dl)	4.84±0.37 ^{a}	3.00±0.47 ^{b}	3.67±0.56 ^{ab}
AG_RATIO	0.99±0.11 ^{ab}	1.18±0.15 ^{a}	0.64±0.17 ^{b}
Creatinine(mg/dl)	1.20±0.10 ^{b}	1.30±0.13 ^{b}	2.13±0.15 ^{a}
Urea (mg/dl)	44.3±3.53 ^{b}	40.50±4.66 ^{b}	61.67±5.39 ^{a}
BUN (mg/dl)	20.7±1.65 ^{b}	18.92±2.18 ^{b}	28.81±2.52 ^{a}
Na (mEq/l)	152 ±1.20 ^{a}	148±1.60 ^{a}	140±1.80 ^{b}
K(mEq/l)	4.67±0.16 ^{b}	4.30±0.21 ^{b}	5.27±0.24 ^{a}
CL (mEq/l)	101 ±1.10 ^{a}	102±1.40 ^{a}	96±1.60 ^{b}
Ca (mg/dl)	9.26±0.06 ^{a}	10.25±0.08 ^{a}	6.97±0.09 ^{b}
P(mg/dl)	7.17±0.08 ^{a}	6.65±0.1 ^{a}	4.90±0.12 ^{b}
Mg (mg/dl)	3.11±0.08 ^{a}	2.35±0.11 ^{a}	1.13±0.13 ^{b}

Values with different superscript letters within the same row differed significantly at $p<0.05$.

3.3. Ruminal Juice examination:

Physical examination of ruminal juice of SI group showed no significantly changed color, odor and consistency, while there was a significant increase in the sedimentation activity time. In contrast, Color, odor and consistency of ruminal juice were changed and the sedimentation activity time showed a highly significant increase in RA group. Microscopical examination showed a significant decrease in protozoal activity and count in both RA and SI groups compared to control group. Biochemically, there was a significant decrease in ruminal pH and significant increase in Methylene blue reduction test time in both RA and SI groups compared to control group. (Table 4).

Table (4): Ruminal parameters in Control group, SI group and RA group.

Parameter	Control (n=7)	SI (n=4)	RA (n=3)
Color	-Olive green -Yellowish Brown	-Olive green -Yellowish Brown	-yellowish - Milky grey
Consistency	Slightly Viscous	Slightly Viscous	Watery
Odor	Aromatic	Aromatic	Soured
SAT(minutes)	6.30±0.24 ^{c}	14.75±0.27 ^{b}	39.67±0.31 ^{a}
Protozoal Activity	++++	++	+ or 0
Protozoal count	3.77±0.16 ^{a}	2.10±0.21 ^{b}	0.63±0.25 ^{c}
PH	7.17±0.13^{a}	5.65±0.13^{b}	4.90±0.13^{c}
MBRT(minutes)	1.59±0.13 ^{c}	5.18±0.17 ^{b}	16.13±0.20 ^{a}

Values with different superscript letters within the same row differed significantly at $p<0.05$.
+++ = highly motile and overcrowded, ++ =motile and crowded,
+ = sluggish motile and low number and 0 = no a live protozoa.

3.4. Ultrasonographic examination

Ultrasonographic examination of digestive system in healthy camels (control group) where the rumen was visualized from left paralumbar fossa, the caudodorsal ruminal sac was visualized close to the spleen and left kidney (Figure 1). The reticulum was best visualized from the right paramedian region just behind the sternal pad. The reticulum had a thick wall that appeared as a half-moon-shaped structure with an even contour (Figure 2 A). The abomasum could be visualized from the right side at (8th - 9th) intercostal space (ICS). The abomasal wall appeared as echogenic line and its contents appeared hypoechoic and homogenous. (Figure 3 A). Small intestinal structures were best seen low in the right paralumbar fossa, Its contents were almost very hypoechoic, homogenous. (Figure4 A). The cecum was visualized in the caudal right flank area. The spiral colon was imaged in the ventral part of right paralumbar fossa; it appeared as thick echogenic arched lines. The liver in camel was visualized at (5th -11th)ICS. The hepatic parenchyma was moderately echogenic. The Portal vein was differentiated from the hepatic veins by stellate ramifications in the area of the portal fissure (Figure 5 A). The CVC appeared as a triangle (Figure 5 B). The spleen was imaged from the left paralumbar fossa, it was present close to dorsal ruminal sac and left kidney, its texture appears hyper echoic than liver. (Table 5).

Ultrasonographic examination of digestive system in SI and RA groups showed some changes with regard to the measures of the digestive canal. The dorsal ruminal sac wall, reticular wall and abomasal wall were significantly increased in RA grouponly (Figure 2 B). The small intestine diameter was significantly increased in SI and RA groups in compare to control group. Regarding to the ultrasonogram of the digestive canal, there was mild displacement of abomasum to cover the liver and increase in abomasal and small intestine contents echogenicity in both SI and RA groups. (Table 5, Figure 3, 4B,C).

Table (5): Changes in digestive system measures of control group, SI group and RA group.

Parameter	Control (n=7)	SI (n=4)	RA (n=3)
Dorsal ruminal sac wall(cm)	0.58±0.02 [b]	0.52±0.03 [b]	0.95±0.04 [a]
Reticular wall(cm)	0.68±0.12 [b]	0.63±0.16 [b]	1.12±0.18 [a]
Abomasal wall(cm)	0.65±0.05 [b]	0.67±0.06 [b]	0.79±0.07 [a]
Small intestine diameter(cm)	0.90±0.06 [b]	4.90±0.11 [a]	3.46±0.13 [a]
Cecal wall(cm)	0.43±0.03 [a]	0.45±0.04 [a]	0.39±0.05 [a]
Cecal diameter(cm)	7.64±0.17 [a]	7.9±0.22 [a]	8.0±0.25 [a]
Colon wall(cm)	0.62±0.05 [a]	0.54±0.06 [a]	0.55±0.07 [a]
Caudle glandular sac wall(cm)	0.58±0.06 [a]	0.57±0.05 [a]	0.57±0.05 [a]
Portal vein(cm)	1.98±0.1 [a]	1.80±0.13 [a]	2.17±0.15 [a]
Caudle vena cava(cm)	2.43±0.17 [a]	2.01±0.22 [a]	1.96±0.25 [a]
Spleen wall(cm)	0.49±0.03 [a]	0.42±0.04 [a]	0.45±0.04 [a]
Spleen diameter(cm)	5.26±0.24 [a]	5.53±0.32 [a]	5.57±0.36 [a]

Values with different letters within the same row differed significantly at p<0.05.

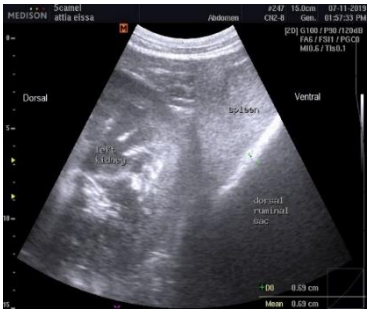


Figure (1): Ultrasonogram of the rumen in healthy camel (control)

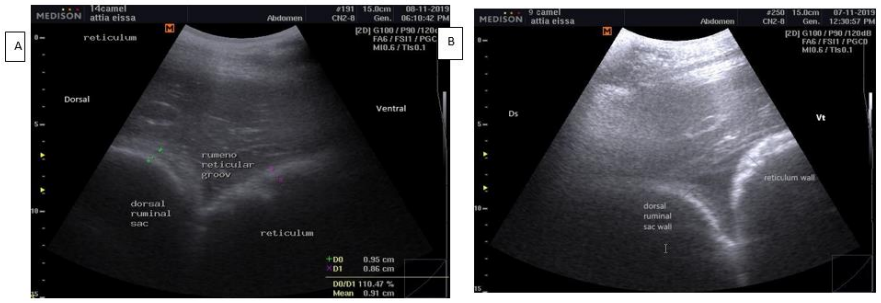


Figure (2): Ultrasonogram of the reticulum and dorsl ruminal sac A- control group B- RA group

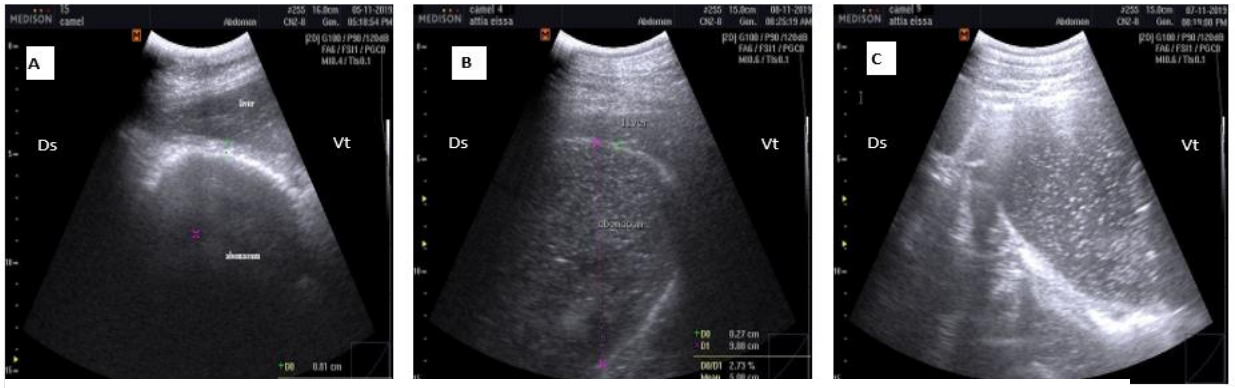


Figure (3): Ultrasonogram of abomasum in camel A- control group B- SI group C- RA group

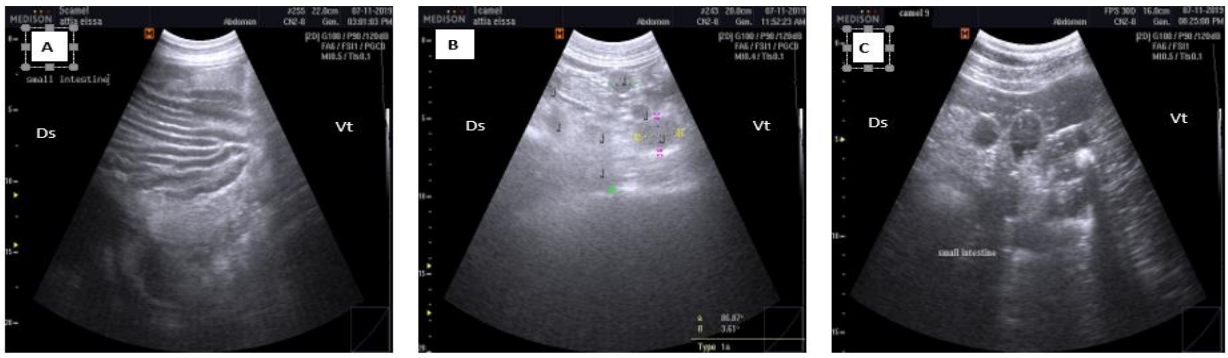


Figure (4): Ultrasonogram of small intestine in camel A- control group B- SI group C- RA group

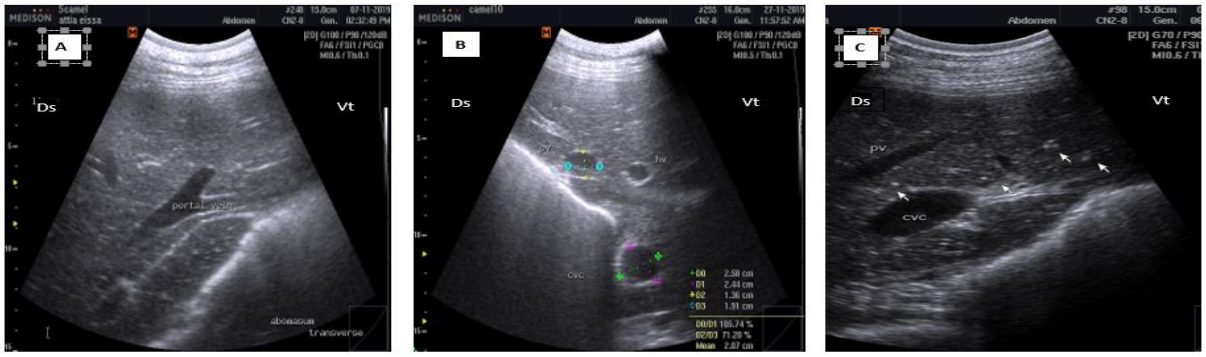
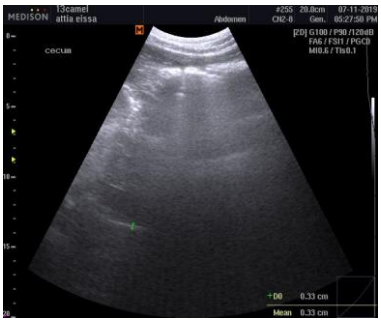


Figure (5): Ultrasonogram of the liver in camel A- Portal vein B- CVC C- echogenic dots



6): Ultrasonogram of the Cecum of healthy camel.

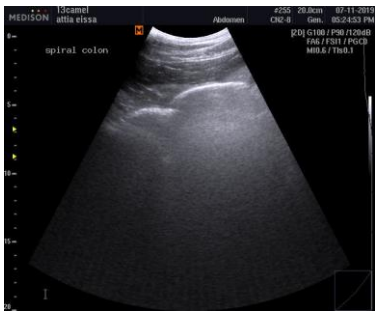
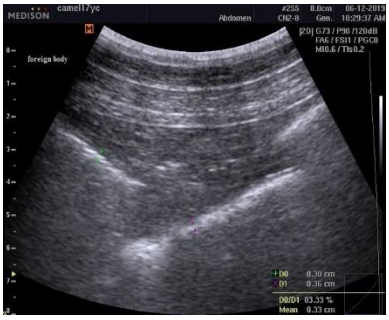


Figure (7): Ultrasonogram of the colon of healthy camel.



Figure(8): Ultrasonogram of camel showing foreign bodies in the ventral ruminal sac

4. DISCUSSION

This study investigated the clinical, haematobiochemical, ultrasonographical and ruminal juice changes in camels naturally diagnosed in the field with various digestive troubles. In our study, there was a significant increase in body temperature in RA group only. This result was close to that obtained by Elbehiry (2005). Owing to the negative relationship between ruminal pH and temperature, the elevated body temperature was attributed to a rise in ruminal temperature caused by the high pH of ruminal juice (Antanaitis et al., 2016)**.** there were significant increase in pulse and respiratory rate in RA group only, this result agreed to result obtained by Baraka et al. (2000)**.** The increase in pulse and respiratory rate were attributed to the decrease of ruminal pH and excessive production of lactic acid, histamine and methanol which affects on vital organs and nerve centers (Radostits et al., 2007)**.** There was a significant decrease in ruminal motility in both RA and SI groups, this result was in agreement with Elbehiry (2005). Ruminal motility can be diminished as a result of rumen atony caused by low pH (Elbehiry, 2005)**.** In terms of hematological findings, there were a significant increases in RBCs, PCV%,WBCS and plateletsin RA group only, which was caused by haemoconcentration and dehydration (Radostits et al., 2007).

With respect to the biochemical changes, there was significant increase in ALT, AST, and GGT in RA group only. These results were in accordance to result obtained by Elnady et al. (2019). The increased activity of ALT reflects the hepatocellular damage which may be sub lethal degeneration or necrosis and the increased activity of AST may be due to hepatocellular damage or degenerated skeletal muscles**.** On the other hand, there was a significant decrease in ALP in RA group only which could be attributed to the excretion of ALP in feces 50 fold in acidotic group(Minuti et al., 2014)**.** There were significant decrease in total proteins, albumin, globulin and A/G ratio in RA group only, this result matched with the finding of Elnady et al. (2019).this could be attributed to the excretion of these parameters in the intestinal lumen with diarrhea (Cao et al., 1987)**.** There was a highly significant rise in urea, BUN, and Creatinine levels in RA group only, which corresponded to the results obtained by Elnady et al. (2019). The increased kidney functions indicate a decreased glomerular filtration rate, renal damage or reduction in effective renal flow and drop in the arterial blood pressure in camels suffered from ruminal acidosis which results in subnormal function as stated by Zein-eldin (2013). There was a highly significant decrease in serum levels of calcium, phosphorus magnesium, sodium and chloride while potassium level was significantly increased in RA group only. These results agreed with that obtained by Zein-eldin (2013)**,** the decrease in serum sodium and chloride may be due to the shift of these electrolytes by osmolarity from the blood to hyper tonic rumen (due to high lactic acid increase hypertonicity in rumen) or due to their losses (Cl and Na) in lactic acidosis associated with diarrhea (Enemark, 2008)**.**The hyperkalemia could be attributed to haemoconcentration related to lactic acidosis. The drop in calcium levels may be due to a temporary malabsorption triggered by weakened intestinal mucosa (Radostits et al., 2007) and the decrease in phosphorus could be caused by recycling large amounts of phosphorus by saliva and the rumen, resulting in variations in its level. Phosphorus in the ruminal juiceis necessary to maintain the activity of ruminal flora and consequently a proper digestion of food (Schwegler et al., 2014)**.** There were no significant changes in biochemical parameters in

camels suffered by simple indigestion. similar results were obtained by Elbehiry (2005)**.**

In terms of ruminal juice examination, there was a variation in color from yellowish to milky grey, soured odor, watery consistency in RA group only. SAT showed a significant increase in both RA and SI groups. These results were in accordance to Baraka et al. (2000) and Elbehiry (2005) these changes caused by excessive production of lactic acid(Radostits et al., 2007)**.**The increased SAT time was attributed to decreased ruminal microflora activity (Kimberling, 1988)**.**Microscopic examination of ruminal juice revealed a significant decrease in protozoal activity and count in both RA and SI groups. These results similar to Elnady et al.(2019)**.** Death of microflora may be due to decrease of ruminal pH and increase level of lactic acid as the microflora accustoms the life in neutral media 6.2-7.2 (Steen, 2001)**.** The Biochemical analysis of ruminal juice showed significant decrease in ruminal pH and significant increase in time of MBRT in both RA and SI groups, The decreased rumen pH was due to increase production of lactic acid, Methylene blue reduction test used as guide to evaluate the activity of microflora(Elnady et al., 2019)**.**These results were in accordance to Baraka**.**

Regarding the ultrasonographic examination, rumen and reticulum wall was significantly increased in RA group only. This increase could be attributed to chemical rumenitis caused by increase of lactic acid and its absorption that results in lactic acidosis (Allen et al., 2005)**.**There was increase in echogenicity of abomasal and small intestine contents and increase in small intestine diameter in both RA and SI groups, these changes can be attributed to change of consistency of ruminal fluid due to increase the amount of fluids withdrawn from the extracellular fluid space into the rumen and consequently permit passing of ruminal liquor to abomasum and the small intestine (Radostits et al., 2007)**.**

5. CONCLUSION

It is concluded that different types of indigestion-particularly the ruminal acidosis-may produce hematobiochemical and ultrasonographical changes in camels. Therefore, camels should be monitored for digestive troubles because of their higher occurrence in camel practice.

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CONFLICT OF INTEREST

No conflict of interest

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